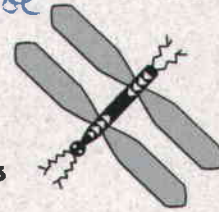


C/007/047 Incoming
cc: Steve A
Dana
Joe

Center for

Water Advocacy

Water Law and Policy Services



February 25, 2009

Daron R. Haddock
Department of Natural Resources
Division of Oil Gas and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, UT 8414-5801

RE: Incomplete Petition for Unsuitability, Kinney #2 Mine, C/007/0047

Dear Mr. Haddock:

I am in receipt of your letter dated January 12, 2009 regarding the Center for Water Advocacy's (CWA's) Petition for Unsuitability for the area encompassed by the Kinney Coal Mine application (Petition). We have the following response to your claim that our petition is incomplete: 1) My notarized signature now appears on the attached petition which we are presenting for re-filing to your office; 2) I have attached the relevant maps indicating the size and location of the area encompassed by the petition; 3) I have correctly identified the legal owners of the surface and subsurface in the attached petition; and 4) We disagree that the petition "fails to set forth the evidence supporting your allegation of fact with detailed information."

This statement ignores over 20 pages of justification attached to the Petition stating in detail multiple problems with locating a coal mine within the city limits of the town of Scofield, Utah. In particular, we do not understand how our petition could be, in your words, "perhaps frivolous" due to the severe human health hazards of placing an active coal mine within a residential area. Never-the-less, as scientific proof of the human health hazards of such mines, I have attached a copy of "Relations Between Health Indicators and Residential Proximity to Coal Mining in West Virginia" regarding the human health effects of residents located near active coal mines and "The Mortality from Heart, Respiratory, and Kidney Disease in Coal Mining Areas of Appalachia," by Micheal Hendrix Associate Professor, Department of Community Medicine West Virginia University. (Attachment 4).

Finally, based on our answer to item 11(C) in the Petition, which clearly states that "coal mining is a threat to human health and the environment in and around Scofield as illustrated by the recent release of coal dust into the watershed by the Skyline Mine" and the fact that we attached the enforcement report by the Utah Department of Natural Resources indicating that a significant contamination problem had occurred in August of 2008 to from this Mine", the Petition clearly addresses your representation that in "light

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50 N. Main St.
Moab, UT 84532

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hshepherd@uci.net

of the past mining that has occurred near the town of Schofield for decades, the burden is yours to establish facts to support your allegation, that mining is incompatible with existing land use plans or programs that mining will affect fragile or historic lands.”

Finally, simply because mining has occurred historically in the area, does not necessarily mean that such activity is compatible within the city limits of Scofield or that fragile or historic landscapes will not be impacted. This is best illustrated by the fact that the “decades” of historic mining near the town of Scofield includes an incident in May of 1900 in which 200 miners died as a result of an explosion and asphyxiation in one such mine. That such threats to human health and the environment are still a reality in Carbon County is illustrated by the fact that, just last week, the West Ridge Coal Mine near Price was forced to shut down for the third time in two weeks due to safety concerns.

Please contact me if you have further questions regarding our amended petition.

Sincerely,



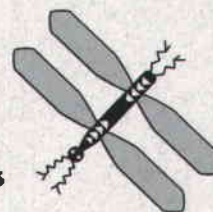
Harold Shepherd, Executive Director

Cc: Gerry Pits
Joel Ban

Center for

Water Advocacy

Water Law and Policy Services



K

December 9, 2008

Dana Dean, Associate Director
Division of Oil, Gas, and Mining
1594 W. North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801
ogmcoal@utah.gov

RE: Petition for Unsuitability - Kinney Mine

Dear Dana:

The Center for Water Advocacy (CWA) appreciates this opportunity to provide the attached Petition for Unsuitability in relation to the Kinney Coal Mine Application Mining and Reclamation Permit Application-Kinney Mine (the Application) submitted by Carbon Resources LLC of Albuquerque, New Mexico. CWA is a non-profit public interest entity dedicated to protecting water resources and interests of its members and the general public in Utah and the west. CWA conducts legal and scientific research, analysis, policy and litigation in its efforts to protect and restore water quantity, water quality and water rights for the health of the watershed ecosystem, preservation of cultural identity and the benefit of its members. CWA retains members who live in the town of Schofield, Utah were a portion of the main will be located. These members have an interest which is or may be adversely affected by the decision on the application. R645-300-123.100.

Based on the attached Petition, we request that the State withdraw the Kinney Coal Mine area from coal or other mining activity. Please contact me if you have any questions regarding our comments or request.

Sincerely,

Harold Shepherd, Executive Directive

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DIV. OF OIL, GAS & MINING

PETITION FOR UNSUITABILITY

(Coal Mining and Reclamation Operations)



Instructions:

Complete the petition, sign and notarize. Attach the required maps (See Box 6).

Mail or Deliver to: State of Utah, Division of Oil, Gas and Mining,

1594 West North Temple, Suite 1210, P.O. Box 145801, Salt Lake City, UT 84114-5801.

1. Petitioners Name:	<i>The Center for Water Advocacy</i>
2. Address:	<i>P.O. Box 331 Moab, UT 84532</i>
3. Telephone Number:	<i>(541) 377-0960</i>
4. Legal Description of Area Covered by Petition: (Township, range, section#) <i>Sections 32 and 33 of Township 12 South, Range 7 East northeast of Scottfield, Carbon County, Utah.</i>	
5. Identification of Petitioners Adversely Affected Interest: <small>This statement must include how the petitioner meets an "injury-in-fact" test by describing the injury to his or her specific affected interests and demonstrate how he or she is among the injured. (R645-103-422.300, R645-103-422.400)</small> <i>Petitioners members, some of whom live in the town of Scottfield, will be directly affected by the proposed Kinney Coal Mine No. 2 located 1/2 mile north of Scottfield. This mine will directly impact such members health through air, noise and water pollution. In addition, there is insufficient water availability for the mine and, the mine will impact the use of water by petitioners members. In addition, petitioners members use the area of the mine and surrounding area for aesthetic and recreational pursuits including hiking, hunting, fishing and aesthetics. These activities will be directly and irreversibly harmed by the mine, thereby directly harming such members.</i>	
6. Provide map(s) marked to show location and size of area under petition: <small>Attach to this petition USGS 7 1/2 minute topographic map(s) or if unavailable, 15-minute map(s) (R645-103-422.500)</small>	
7. Legal Owners of Record of the Property: (R645-103-422.610) SURFACE: <i>Of the 452.5 surface acreage for the Kinney No. 2 Mine, 15.3 acres are owned in fee by Carbon Resources, LLC wholly owned subsidiary of Western Reserve Coal Corporation. The remaining 437.2 acres owned by Evangelos George Telenis, ETAL, of this 22.8 acres are held by Carbon Resources as an Easement from George Telenis, ETAL. (See Mining and Reclamation Permit App. Kinney No. 2 Mine page 1.0-5)</i> SUBSURFACE: <i>Coal ownership for the permit area is held by Carbon County, Utah. (See Mining and Reclamation Permit App. Kinney No. 2 Mine, page 2.1-2)</i>	
8. Holders of Record (if any) of any Leasehold Interest: (R645-103-422.620) <i>Carbon County has leased the coal ownership to Western Reserve Coal, Inc. effective March 6, 1997. (Lease document recorded in Carbon County Recorder's Office Book 385, page 396), as amended December 31, 2002, (recorded in the Carbon County Recorder's Office in Book 523, page 522). The coal is subleased from Western Reserve Coal to DRLC, LLC, which sublease is recorded in the Carbon County Recorder's Office in Book 607, page 768. The owner of Carbon Resources LLC and subleased from DRLC, LLC to</i>	
9. Purchasers of Record (if any) to the Property Under a Real Estate Contract: (R645-103-422.630) <i>Of the 452.5 surface acreage for the Kinney No. 2 Mine, 22.8 acres are held by Carbon Resources, LLC as an Easement from George Telenis, ETAL. (See Mining and Reclamation Permit App. Kinney No. 2 Mine, page 1.0-5).</i>	

Carbon Resources, LLC (which sublease is recorded in the Carbon County Recorder's Office in Book 607, Page 771).

10. Check the appropriate criteria and provide the allegation of fact and the supporting evidence (based on competent and scientifically sound data and information) for designating areas unsuitable pursuant to R645-103-320. (Attach additional sheets and sources as necessary)

(R645-103-422.700)

- ☐ Reclamation is not technologically and economically feasible under the State Program. (R645-103-321)
- ☒ Operations will be incompatible with existing state or local land use plans or programs. (R645-103-322.100)
- ☒ Operations will affect fragile or historic lands and could result in significant damage to important historic, cultural, scientific or aesthetic values or natural systems. (R645-103-322.200)
- ☒ Operations will affect renewable resource lands and result in a substantial loss or reduction of long-range productivity of water supply or of food or fiber products. (R645-103-322.300)
- ☒ Operations will affect natural-hazard lands and could substantially endanger life and property. (R645-103-322.400)

(See Attachment 1)

11. Provide Information (including competent and scientifically sound data sources) about:

(Attach additional sheets and sources as necessary)

A. The potential coal resources of the petition area:

(See Attachment 2)

(R645-103-422.810)

B. The demand for coal resources:

(R645-103-422.812)

C. The impact of the unsuitability designation on the environment, economy and supply for coal:

(R645-103-422.813)

The environmental, fish and wildlife habitat will be protected by the unsuitability designation. Coal mining is a threat to human health and the environment in and around the area as illustrated by the recent release of coal dust into the watershed by the Skyline Mine.

(See Attachment 3)

12. Provide other information as may appropriately affect a determination on the petition:

(R645-103-422.820)

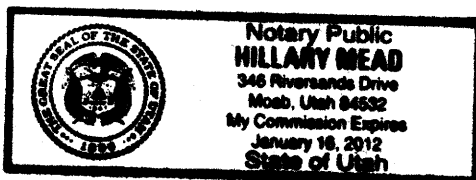
Petitioners Signature

Harold S. Shepherd
Print Name

Executive Director
Title

Subscribed and sworn before me this 26th day of February, 20 09

Notary Stamp:



Utah Criteria for Designating Areas as Unsuitable for Coal Mining and Reclamation Operations.

Under R645-10-300 CWA would like to request that the area designated for mining by the Application be designated as unsuitable for coal mining and reclamation operations, because the operations as provided in the Application will:

- a) Be incompatible with existing state or local land use plans or programs;

The mine is located up stream from a trophy fishing reservoir under the jurisdiction of Utah State Parks. In addition, once the mine becomes active there will potentially be hundreds of freightliner capacity trucks carrying produced coal down highway 96 which runs through the town of Scofield and along the Scofield Reservoir. In addition to presenting a traffic hazard, this level of truck traffic will interfere with the use and enjoyment of the Reservoir by visitors and members of the community.

- b) Affect fragile or historic lands in which the activities could result in significant damage to important historic, cultural, scientific, or aesthetic values or natural systems;

The mine will be located within the city limits of the town of Scofield, UT. This town is highly dependent up the tourism economy which will be severally impacted by the noise, visual and water pollution resulting from the mine and the human health impacts of coal mining near residential and commercial buildings and activity.

- c) Affect renewable resource lands in which the activities could result in a substantial loss or reduction of long-range productivity of water supply or of food or fiber products; or

The mine will be located next to Mud Creek which contains a valuable fishery and other aquatic resources. That this type of mining activity is potentially detrimental to water quality in the Creek and elsewhere is illustrated by the leak of "fine coal" into clear Creek during the summer of 2008 and which was never cleaned up but did result in a fine being levied by DOGM. See Attachments D-E.

- d) Affect natural-hazard lands in which the operations could substantially endanger life and property, such lands to include areas subject to frequent flooding and areas of unstable geology.

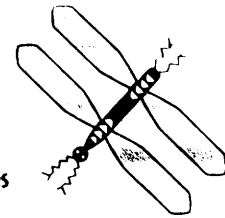
The mine will be located within the city limits of the town of Scofield, UT. The human health impacts of coal mining near residential and commercial buildings and activity will be high. *See Appendix C-F.*

- Attachment 1

Center for

Water Advocacy

Water Law and Policy Services



September 30, 2008

Dana Dean, Associate Director
Division of Oil, Gas, and Mining
1594 W. North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801
ogmcoal@utah.gov

RE: Comments and Request for Informal Conference on Mining and Reclamation Permit Application-Kinney Mine

Dear Dana:

The Center for Water Advocacy (CWA) appreciates this opportunity to provide comments and to Request an Informal Conference on the Kinney Coal Mine Application Mining and Reclamation Permit Application-Kinney Mine (the Application) submitted by Carbon Resources LLC of Albuquerque, New Mexico. CWA is a non-profit public interest entity dedicated to protecting water resources and interests of its members and the general public in Utah and the west. CWA conducts legal and scientific research, analysis, policy and litigation in its efforts to protect and restore water quantity, water quality and water rights for the health of the watershed ecosystem, preservation of cultural identity and the benefit of its members. CWA retains members who live in the town of Schofield, Utah were a portion of the main will be located. These members have an interest which is or may be adversely affected by the decision on the application. R645-300-123.100. We hope that the following comments and requests will be helpful in the Utah Department of Oil, Gas and Minings (DOGM's) decision making process regarding the Application and addressing CWA's concerns about potential impacts to water resources.

i. The Application Lacks Information as Required by the Surface Coal Mining Regulations

The Application does not comply with the Utah Coal Mining Permit Regulations (UCMPR or Rules). Specifically, R645-301-300-Biology; R645-301-600 Geology; R645-301-800-Bonding and Insurance; R645-301-200-Soils; R645-301-400- Land Use and Air Quality or R645-301-700-Hydrology because it lacks information required by these regulations.

a. General Requirements

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bshpherd@uct.net

The UCMPR, provides that all water quality analyses must meet:

the requirements of R645- 301-723 through R645-301-724.300, R645-301-724.500, R645-301-725 through R645-301-731, and R645-301-731.210 through R645- 301-731.223 will be conducted according to the methodology in the current edition of "Standard Methods for the Examination of Water and Wastewater"¹ or the methodology in 40 CFR Parts 136 and 434. Water quality sampling performed to meet the requirements of R645-301-723 through R645-301-724.300, R645-301-724.500, R645-301-725 through R645-301-731, and R645-301- 731.210 through R645-301-731.223 will be conducted according to either methodology listed above when feasible.

R645-301-723. The water quality analysis, in the Application, however, fails to meet these requirements.

c. Baseline Information

The UCMPR, provides that:

The application will include the following baseline hydrologic, geologic and climatologic information, and any additional information required by the Division...Ground Water Information. The location and ownership for the permit and adjacent areas of existing wells, springs and other ground-water resources, seasonal quality and quantity of ground water, and usage. Water quality descriptions will include, at a minimum, total dissolved solids or specific conductance corrected to 25 degrees C, pH, total iron and total manganese. Ground-water quantity descriptions will include, at a minimum, approximate rates of discharge or usage and depth to the water in the coal seam, and each water-bearing stratum above and potentially impacted stratum below the coal seam...Surface water information. The name, location, ownership and description of all surface- water bodies such as streams, lakes, and impoundments, the location of any discharge into any surface-water body in the proposed permit and adjacent areas, and information on surface-water quality and quantity sufficient to demonstrate seasonal variation and water usage. Water quality descriptions will include, at a minimum, baseline information on total suspended solids, total dissolved solids or specific conductance corrected to 25 degrees C, pH, total iron and total manganese. Baseline acidity and alkalinity information will be provided if there is a potential for acid drainage from the proposed mining operation. Water quantity descriptions will include, at a minimum, baseline information on seasonal flow

¹ "Standard Methods for the Examination of Water and Wastewater" is a joint publication of the American Public Health Association, the American Water Works Association, and the Water Pollution Control Federation and is available from the American Public Health Association, 1015 Fifteenth Street, NW, Washington, D. C. 20036.

These drainage classifications indicate that the Scofield Reservoir and associated tributaries are designated for culinary use when treated, recreation, as cold water non-game fish habitat, and irrigation and stock watering with no associated natural resource waters restrictions other than applicable effluent standards for discharges.

App. at 3.7-19.

This does not satisfy the PHC determination analysis requirement which "will be based on baseline hydrologic, geologic and other information collected for the permit application and may include data statistically representative of the site." 728.200.

Nor does the Application include a discussion of the PHC determination which will include findings on... Whether adverse impacts may occur to the hydrologic balance and... Whether acid-forming or toxic-forming materials are present that could result in the contamination of surface- or ground-water supplies. 728.300-320. Instead, the Application justifies this lack of required analysis by stating that:

Not applicable to Kinney Mine because no waste materials – incidental roof and floor rock – will be shipped out with the coal.

App. at 4.7-34.

Yet, the Application fails to provide what will be done with waste materials. In addition, the Rules provide that the Application must describe the "impact the proposed coal mining and reclamation operation will have on:...Sediment yield from the disturbed area." 728.330-331.

Minor Reductions in Surface Flows and Alteration of Surface Flow Patterns Due to Operation of the Sedimentation Structure - Although sedimentation ponds are integral to mitigating mining related impacts on the surface hydrologic system, operation of sedimentation ponds tends to reduce discharge flow volumes and extend the period of effective flow for runoff from both snowmelt and thunderstorm events. In effect, sedimentation ponds function as limited capacity flood control structures reducing the effective discharge rate for large volume flows through temporary storage and flow routing. The sedimentation pond is designed to gradually release impounded runoff following required retention for sediment control. Given provisions for retention and gradual discharge of retained storm flows, most of the runoff is returned to the surface drainage system with only a short lag time corresponding to the design retention time for the pond.

App. at 4.7-33.

Nor does the Application provide a plan for what happens to the land when mining ends. This is regardless of the fact that:

a post-mining land use program must be established in a Mining and Reclamation Plan and approved before mining begins. When mining stops, regulations require that the mine be sealed and the surface area be returned to approximate the original land contour, or conform to the

Further the rules require that the application include a description of whether "the proposed SURFACE COAL MINING AND RECLAMATION ACTIVITY will proximately result in contamination, diminution or interruption of an underground or surface source of water within the proposed permit or adjacent areas which is used for domestic, agricultural, industrial or other legitimate purpose" 728.340 and Whether the UNDERGROUND COAL MINING AND RECLAMATION ACTIVITIES conducted after October 24, 1992 may result in contamination, diminution or interruption of State-appropriated Water in existence within the proposed permit or adjacent areas at the time the application is submitted. 728.350.

The Application, however, dismisses these requirements by concluding that:

As discussed in Section 3.7, Hydrology Description, under the subheading water rights and replacement, and in Section 4.7.4.2, Potential for Adverse Effects, CR's mining and related operations are not expected to adversely impact any surface or ground water rights. Consequently, there is no reason to explicitly address provisions for replacement of impacted water rights at this time.

App. at 4.7-34.

Under Section 3.7, however, the only reference to the impacts to surface water rights provides that:

Since the mine is projected to be dry, and is not anticipated to have a mine discharge, there are no anticipated to be dry, and is not anticipated to have a mine discharge, there are no anticipated additive effects upon the local surface waters. In a similar manner, no impacts are believed possible to surface waters located within or west of Pleasant Valley and Mud Creek since surface drainages are discontinues east and west of the valley.

App. at Sect. 3.7-22.4

As a result, the Applicant fails to provide any justification such as well data, surface and ground water flow or any studies on water availability to justify this statement. As a result, the Application illegally circumvents the requirement of providing water rights and availability information by reaching an arbitrary and unfounded conclusion that such impacts will not take place.

Further the Application provides:

In the unlikely event...that proximate contamination, diminution, or interruption does occur, CR will mitigation these impacts through the purchase and augmentation of effected water rights, monetary

4 The Table of Context in the Application provides that there is also a discussion of ground water rights which are potentially impacted by the Mine on page 3.7-17. However, no such discussion of such water rights is found on this page or elsewhere in the Application.

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impacts of the operation upon the hydrologic balance:...At all monitoring locations in streams, lakes and impoundments, that are potentially impacted or into which water will be discharged and at upstream monitoring locations, the total dissolved solids or specific conductance corrected to 25 degrees C, total suspended solids, pH, total iron, total manganese and flow will be monitored; and For point-source discharges, monitoring will be conducted in accordance with 40 CFR Parts 122 and 123, R645-301-751 and as required by the Utah Division of Environmental Health for National Pollutant Discharge Elimination System (NPDES) permits. 731.220-222.2

Further the Rules provide that:

the permit application will contain a description of measures to be taken to obtain Division approval for alteration or relocation of a natural drainageway under R645-301-358, R645-301-512.250, R645-301-527.100, R645-301-527.230, R645-301-534.100, R645-301-534.200, R645-301-534.300, R645-301-542.600, R645-301-742.410, R645-301-742.420, R645-301-752.200, and R645-301-762. 732.410.

Rather than address drainageways, however, the Application merely provides:

The primary potential impacts on fish and aquatic species, aquatic habitat, and riparian vegetation which may result from the mining and related activities would be from drainage from the proposed sedimentation pond, or from alternative sediment controls used where drainage from small areas does not report to the sedimentation pond.

App. at 4.3-5.

Impoundments.

In apparent response to the Rules requirements regarding impoundments, the Application provides that:

The sedimentation pond described in the preceding section is the only impoundment which will be utilized for drainage and sediment control purposes in conjunction with the Kinney mining and related operations. Applicable regulatory requirements for impoundments essentially duplicated the specified requirements for sedimentation ponds addressed above. Given limited pond size and capacity, the minimum design freeboard of 1 foot is more than adequate to resist overtopping of the embankment due to wave action or sudden increases in inflow.

App. at 4.7-25.

This description, however, completely fails to comply with the rules provisions for "General Plans" which requires that:

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Instead of compliance with R645-301-748 or the temporarily sealing standard, however, the Application merely provides that groundwater level measurements, field water quality parameters and laboratory samples were taken following well installation and development, undefined "baseline sampling" and well monitoring was conducted for several wells in the project area.

App at 4.7-14.

Design Criteria and Plans

The Application fails to contain any of the following required information:

"Each permit application will include site-specific plans that incorporate minimum design criteria as set forth in R645-301-740 for the control of drainage from disturbed and undisturbed areas." 741.

Impoundments meeting the criteria of the MSHA, 30 CFR 77.216(a) will comply with the requirements of 77.216 and R645-301-512.240, R645-301-514.300, R645-301-515.200, R645-301-533.100 through R645-301-533.600, R645-301-733.220 through R645-301-733.224, and R645-301-743. The plan required to be submitted to the District Manager of MSHA under 30 CFR 77.216 will also be submitted to the Division as part of the permit application.

743.110.

Return of Coal Processing Waste to Abandoned Underground Workings. Each permit application to conduct UNDERGROUND COAL MINING AND RECLAMATION ACTIVITIES will, if appropriate, include a plan of proposed methods for returning coal processing waste to abandoned underground workings as follows:

The plan will describe the source of the hydraulic transport mediums, method of dewatering the placed backfill, retainment of water underground, treatment of water if released to surface streams and the effect on the hydrologic regime;

The plan will describe each permanent monitoring well to be located in the backfilled areas, the stratum underlying the mined coal and gradient from the backfilled area; and

The requirements of R645-301-513.300, R645-301-528.321, R645-301-536.700, R645-301-746.410 and R645-746.420 will also apply to pneumatic backfilling operations, except where the operations are exempted by the Division from requirements specifying hydrologic monitoring.

Threatened and Endangered Species

The Rules require that the applicant must provide "Listed or proposed endangered or threatened species of plants or animals or their critical habitats listed by the Secretary under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), or those species or habitats protected by similar state statutes." 322.210.

Listed Species

Threatened Species

Bald Eagle _____ *Haliaeetus leucocephalus*
Canada lynx _____ *Lynx Canadensis*

Endangered Species

Whooping crane (extirpated) _____ *Grus Americana*
Black-footed ferret _____ *Mustela nigripes*
(experimental, non-essential
in Duchesne & Uintah counties)

Conservation Agreement Species

Northern goshawk _____ *Accipiter gentilis*

Candidate Species

Yellow-billed cuckoo _____ *Coccyzus americanus*

Species of Concern

Western toad _____ *Bufo boreas*
Smooth greensnake _____ *Opheodrys vernalis*
Burrowing owl _____ *Athene cunicularia*
Ferruginous hawk _____ *Buteo regalis*
Sage Grouse _____ *Centrocercus urophasianus*
Black swift _____ *Cypseloides niger*

Kinney No. 2 Mine
2/18/2008

3.3-27

The Application entirely fails to provide information regarding

Habitats of unusually high value for fish and wildlife such as important streams, wetlands, riparian areas, cliffs supporting raptors, areas offering special shelter or protection, migration routes, or reproduction and wintering areas; or ... Other species or habitats identified through agency consultation as requiring special protection under state or federal law.

322.220-230.

Operation Plan.

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impoundments, establishment of vegetation for wildlife food and cover, and the replacement of perches and nest boxes. Where the plan does not include enhancement measures, a statement will be given explaining why enhancement is not practicable.

Geology

The Rules provide that:

Geologic information will include, at a minimum, the following:....A description of the geology of the proposed permit and adjacent areas down to and including the deeper of either the stratum immediately below the lowest coal seam to be mined or any aquifer below the lowest coal seam to be mined which may be adversely impacted by mining. This description will include the regional and structural geology of the permit and adjacent areas, and other parameters which influence the required reclamation and it will also show how the regional and structural geology may affect the occurrence, availability, movement, quantity and quality of potentially impacted surface and ground water. It will be based on:....The cross sections, maps, and plans required by R645-301-622.100 through R645-301-622.400...The information obtained under R645-301-624.200, R645-301-624.300 and R645-301-625; and....Geologic literature and practices.

624.100-130

Faults

There are two distinct styles of faulting within the district. The oldest system is a conjugate set of strike-slip and or oblique-slip vertical faults. The dominant half of this set is oriented north ~57deg. west. The minor half of the set is oriented north ~60 east. The most prominent faults in this system form the Fish Creek Graben, the UP-South-Saddle-Fault, the UP-North-Saddle-Fault, and the G-7 Fault. These structures were first formed in the early compressive episode and then were re-activated by regional uplift Figure 3.6-4.

Two other faults, Up-North Saddle Fault, and UP-South Saddle Fault, were formed in the same structural event that formed the fish Creek Graben. These faults limit the north south length of individual mining blocks in the area. See Appendix B.

Transportation

The Application fails to provide any of the required information:

521.170. Transportation Facilities Maps. Each permit application will describe each road, conveyor, and rail system to be constructed, used, or maintained within the proposed permit area. The description will include a map, appropriate cross sections, and specifications for each road width, road gradient, road surface, road cut, fill embankment, culvert, bridge, drainage ditch, drainage structure, and each stream ford that is used as a temporary route.

527. Transportation Facilities.

524.420. All blasting will be conducted between sunrise and sunset unless nighttime blasting is approved by the Division based upon a showing by the operator that the public will be protected from adverse noise and other impacts. The Division may specify more restrictive time periods for blasting;

II. The State has not conducted investigation or requested Information as directed by the Surface Coal Mining Regulations.

The State has not conducted investigation or requested additional data as deemed necessary to ensure compliance with the requirements of the UCMPR under R645-301-300 - Biology; R645-301-600 - Geology; R645-301-800 - Bonding and Insurance; R645-301-200 - Soils; R645-301-400 - Land Use and Air Quality or R645-301-700 - Hydrology. Nor has the division required sufficient supplemental information to evaluate probable hydrologic or environmental consequences and to plan remedial and reclamation activities based on data provided by the Application that adverse impacts on or off the proposed permit area may occur to the hydrological, biological, land, soils or geological resources as required in R645-301-300-Biology; R645-301-600-Geology; R645-301-800-Bonding and Insurance; R645-301-200-Soils; R645-301-400-Land Use and Air Quality or R645-301-700-Hydrology.

The additional information lacking in the application along with the corresponding Surface Coal Mining Regulations includes:

a. Climatological Information

The UMCR provide that:

When requested by the Division, the permit application will contain a statement of the climatological factors that are representative of the proposed permit area, including:...The average seasonal precipitation...The average direction and velocity of prevailing winds; andSeasonal temperature ranges...The Division may request such additional data as deemed necessary to ensure compliance with the requirements of R645-301 and R645-302.

724.400, 410-13 & 420.

724.500. Supplemental information.

If the determination of the PHC required by R645-301-728 indicates that adverse impacts on or off the proposed permit area may occur to the hydrologic balance, or that acid-forming or toxic-forming material is present that may result in the contamination of ground-water or surface-water supplies, then information supplemental to that required under R645-301-724.100 and R645-301-724.200 will be provided to evaluate such probable hydrologic consequences and to plan remedial and reclamation activities. Such supplemental information may be based upon drilling, aquifer tests, hydrogeologic analysis of the water-bearing strata, flood flows, or analysis of other water quality or quantity characteristics.

affected by surface operations incident to an underground mine for UNDERGROUND COAL MINING AND RECLAMATION ACTIVITIES, expressed as average yield of food, fiber, forage, or wood products from such lands obtained under high levels of management. The productivity will be determined by yield data or estimates for similar sites based on current data from the U. S. Department of Agriculture, state agricultural universities, or appropriate state natural resource or agricultural agencies.

Utah Criteria for Designating Areas as Unsuitable for Coal Mining and Reclamation Operations.

Under R645-10-300 CWA would like to request that the area designated for mining by the Application be designated as unsuitable for coal mining and reclamation operations, because the operations as provided in the Application will:

- a) Be incompatible with existing state or local land use plans or programs;

The mine is located up stream from a trophy fishing reservoir under the jurisdiction of Utah State Parks. In addition, once the mine becomes active there will potentially be hundreds of freightliner capacity trucks carrying produced coal down highway 96 which runs through the town of Scofield and along the Scofield Reservoir. In addition to presenting a traffic hazard, this level of truck traffic will interfere with the use and enjoyment of the Reservoir by visitors and members of the community.

- b) Affect fragile or historic lands in which the activities could result in significant damage to important historic, cultural, scientific, or aesthetic values or natural systems;

The mine will be located within the city limits of the town of Scofield, UT. This town is highly dependent up the tourism economy which will be severally impacted by the noise, visual and water pollution resulting from the mine and the human health impacts of coal mining near residential and commercial buildings and activity.

- c) Affect renewable resource lands in which the activities could result in a substantial loss or reduction of long-range productivity of water supply or of food or fiber products; or

The mine will be located next to Mud Creek which contains a valuable fishery and other aquatic resources. That this type of mining activity is potentially detrimental to water quality in the Creek and elsewhere is illustrated by the leak of "fine coal" into clear Creek during the summer of 2008 and which was never cleaned up but did result in a fine being levied by DOGM. See Attachments D-E.

- d) Affect natural-hazard lands in which the operations could substantially endanger life and property, such lands to include areas subject to frequent flooding and areas of unstable geology.

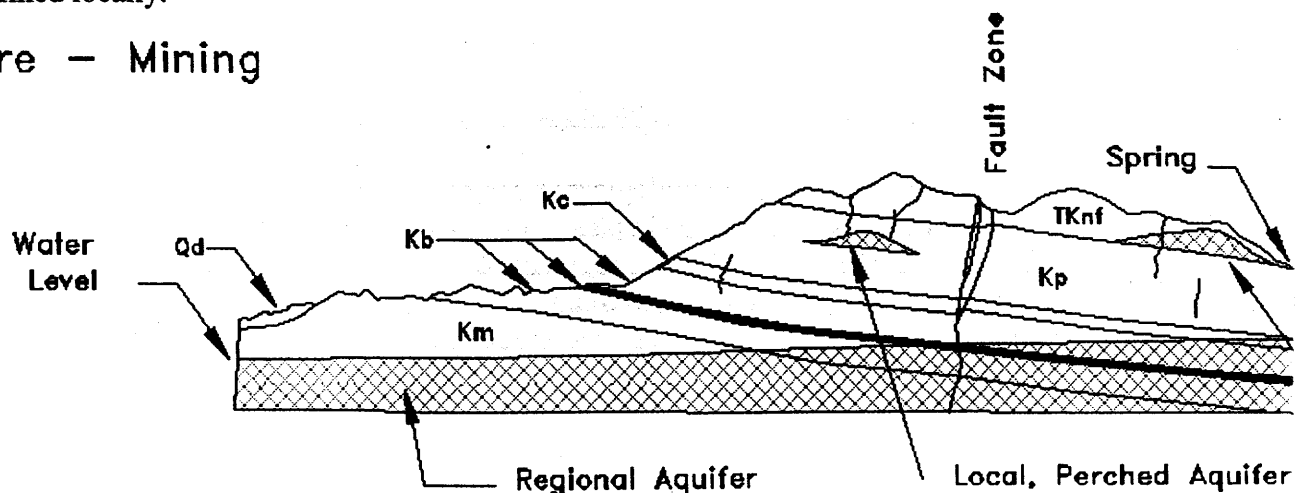
APPENDIX A

I. How Does Mining Intercept Water?

Pre-mining conditions

Below is a cross section depicting the Wasatch Plateau and Book Cliffs coal fields. Also illustrated are perched aquifer and regional aquifer systems. Unconfined ground water in perched aquifers is generally local in extent and influence. A regional water table or aquifer is generally unconfined and crosses formation boundaries, although it may be confined locally.

Pre - Mining

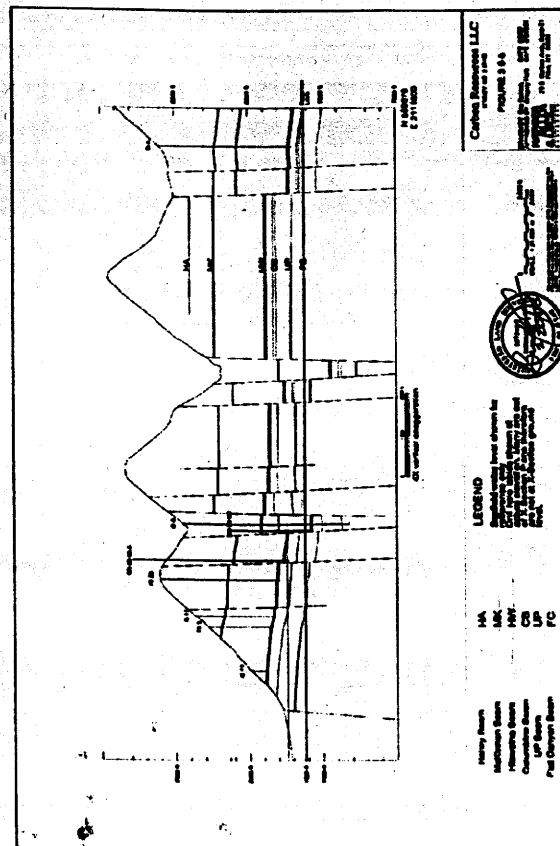


Qd = Quaternary alluvial, colluvial deposits * TKnf = North Horn & Flagstaff Fins * Kp = Price River Formation

Kc = Castle Gate Sandstone * Kb = Black Hawk Formation (coal bearing) * Km = Mancos Shale

Conditions during mining

Underground coal mining can result in subsidence of overlying rock. Cracks from subsidence extend upwards, and can reach the surface and intercept surface water. If rock thickness and strength are sufficient, the cracks will not reach the surface but may intercept ground water in perched aquifers above the mine workings and affect springs fed by these aquifers. If water in the regional aquifer is intercepted by the mine workings, the regional water table may be lowered as water is pumped from the mine to allow coal recovery.



1.0 INTRODUCTION

Carbon Resources LLC (CR) is a wholly owned subsidiary of Western Reserve Coal Corporation, and has prepared this Mining and Reclamation Permit application for the Kinney No. 2 Mine, a proposed new underground mine complex. This permit application has been developed to effect full compliance with applicable permitting requirements under the State of Utah Coal Mining Rules and is being submitted for review and approval of the mining and reclamation plans contained herein by the Utah Division of Oil, Gas and Mining (UDOGM), and other jurisdictional agencies.

1.1 LOCATION AND GENERAL SETTING

The proposed Kinney No. 2 Mine is located one half mile north of Scofield, Utah and east of Utah State Highway 96. Surface facilities will be located at the coal outcrop, and adjacent to the highway. The Kinney Mine permit area covers an area of approximately 448 acres as shown on Figure 1.0-1, General Location Map. Mining is planned in the Hiawatha coal seam from the outcrop at the edge of Pleasant Valley.

Entry will be achieved via an approximately 600 foot wide corridor between old abandoned mine workings and extract coal from multiple fault bounded reserve blocks. Maximum currently anticipated production is 800,000 tons annually utilizing continuous mining methods. Surface facilities are proposed to be located at the site of past mining in Sections 32 and 33 of Township 12 South, Range 7 East northeast of Scofield, Carbon County, Utah.

The Kinney Mine is located just north and east of the Town of Scofield, Utah, on the east side of Utah State Highway 96. The area is part of the Wasatch Plateau in Pleasant Valley, and is characterized by high plateaus to the east and Pleasant Valley to the west. Scofield Reservoir is located to the north and west of the permit area. The mine surface facilities are located on semi-arid mountainous land that is dry and sparsely populated by quaking aspen, a few fir trees, and brush. Within the permit area, topographic relief ranges from 7,650 feet, near the highway to over 8,800 feet on the ridge top east of the portal area.

The area is drained by small unnamed ephemeral channels near the portal area, Eagles Canyon over the ridge to the east of the mine site, and Long Canyon east of Eagles Canyon. All drainages eventually lead to Scofield Reservoir. Eagles Canyon is ephemeral, and Long Canyon contains a perennial stream. Several other very small unnamed ephemeral channels drain the permit area. The climate of the area is semi-arid and, with the exception of the noted perennial drainage, most area drainages flow only in response to spring snowmelt or major thunderstorm events. Ground water occurrence and use in the area is limited by low infiltration and recharge, and the relatively low permeability of most units of the geologic sequence. Soils are generally thin and poorly developed except in drainage valleys, where soil depths can reach 5 feet or more. Area vegetation is typical of semi-arid areas in the west and reflects the wide range of topographic conditions within the proposed



State of Utah
Department of
Natural Resources

MICHAEL R. STYLER
Executive Director

Division of
Oil, Gas & Mining

JOHN R. BAZA
Division Director

JON M. HUNTSMAN, JR.
Governor

GARY R. HERBERT
Lieutenant Governor

Representatives Present During the Inspection:

Company	Gregg Galecki	Environmental Coordinator
OGM	Karl Houskeeper	Environmental Scientist III

Inspection Report

Permit Number:	C0070005
Inspection Type:	COMPLETE
Inspection Date:	Wednesday, August 13, 2008
Start Date/Time:	8/13/2008 9:00:00 AM
End Date/Time:	8/13/2008 2:00:00 PM
Last Inspection:	Thursday, July 10, 2008

Inspector: Karl Houskeeper, Environmental Scientist III

Weather: Clear, Temp. 68 Deg. F.

Inspection ID Report Number: 1732

Accepted by: jhefric
9/8/2008

Permittee: **CANYON FUEL COMPANY LLC**

Operator: **CANYON FUEL COMPANY LLC**

Site: **SKYLINE MINE**

Address: **HC 35 BOX 380, HELPER UT 84526**

County: **CARBON**

Permit Type: **PERMANENT COAL PROGRAM**

Permit Status: **ACTIVE**

Current Acreages

10,374.00	Total Permitted
79.12	Total Disturbed
	Phase I
	Phase II
	Phase III

Mineral Ownership

- ☒ Federal
☒ State
☐ County
☒ Fee
☐ Other

Types of Operations

- ☒ Underground
☐ Surface
☐ Loadout
☐ Processing
☐ Reprocessing

Report summary and status for pending enforcement actions, permit conditions, Division Orders, and amendments:

The following permit conditions have been met or are being met:

1) Water Monitoring data is being submitted in an electronic format to the Division.

2) Canyon Fuel Co. must submit cumulative monthly flow data for discharges into Electric Lake and Eccles Creek. This condition is being met.

The 2007 Annual Report was reviewed as part of the complete inspection. A copy of the 2007 annual report review will be attached.

Inspector's Signature:

Karl R. Houskeeper

Date Wednesday, August 13, 2008

Karl Houskeeper, Environmental Scientist III

Inspector ID Number: 49

Note: This inspection report does not constitute an affidavit of compliance with the regulatory program of the Division of Oil, Gas and Mining.

1594 West North Temple, Suite 1210, PO Box 145801, Salt Lake City, UT 84114-5801
telephone (801) 538-5340 • facsimile (801) 359-3940 • TTY (801) 538-7458 • www.ogm.utah.gov

Permit Number: C0070005
 Inspection Type: COMPLETE
 Inspection Date: Wednesday, August 13, 2008

Inspection Continuation Sheet

Page 2 of 3

REVIEW OF PERMIT, PERFORMANCE STANDARDS PERMIT CONDITION REQUIREMENTS

1. Substantiate the elements on this inspection by checking the appropriate performance standard.
 - a. For COMPLETE inspections provide narrative justification for any elements not fully inspected unless element is not appropriate to the site, in which case check Not Applicable.
 - b. For PARTIAL inspections check only the elements evaluated.
2. Document any noncompliance situation by reference the NOV issued at the appropriate performance standard listed below.
3. Reference any narratives written in conjunction with this inspection at the appropriate performance standard listed below.
4. Provide a brief status report for all pending enforcement actions, permit conditions, Division Orders, and amendments.

	Evaluated	Not Applicable	Comment	Enforcement
1. Permits, Change, Transfer, Renewal, Sale	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2. Signs and Markers	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3. Topsoil	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.a Hydrologic Balance: Diversions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.b Hydrologic Balance: Sediment Ponds and Impoundments	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4.c Hydrologic Balance: Other Sediment Control Measures	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.d Hydrologic Balance: Water Monitoring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4.e Hydrologic Balance: Effluent Limitations	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Explosives	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Disposal of Excess Spoil, Fills, Benches	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Coal Mine Waste, Refuse Piles, Impoundments	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8. Noncoal Waste	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Protection of Fish, Wildlife and Related Environmental Issues	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Slides and Other Damage	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Contemporaneous Reclamation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Backfilling And Grading	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Revegetation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Subsidence Control	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Cessation of Operations	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16.a Roads: Construction, Maintenance, Surfacing	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16.b Roads: Drainage Controls	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Other Transportation Facilities	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Support Facilities, Utility Installations	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. AVS Check	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. Air Quality Permit	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
21. Bonding and Insurance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
22. Other	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

1. Permits, Change, Transfer, Renewal, Sale

The current DOGM permit C/007/005 was issued effective 04/30/2007 and expires 04/30/2012.

-Certificate of Insurance policy number HDO G2 3732920, issued 07/31/2008 and terminates 07/31/2009.

-UPDES permit # UT0023540 effective 12/01/2004 and expires @ midnight 11/30/2009.

-Air Quality permit DAQE-AN0092007-03, issued June 24, 2003.

-SPCC Plan dated 07/07/05. The Plan is P.E. certified, stamped, signed and dated by a Utah P.E.

2. Signs and Markers

The Mine ID signs are at the point of public access to the permit area and contain the required information. All other signs and markers are in accordance with the coal rules.

4.b Hydrologic Balance: Sediment Ponds and Impoundments

The second quarter 2008 pond inspections were done May 28, 2008, no problems were noted.

The sediment pond at the main facilities is currently being cleaned. A hole in the base of the outlet structure allow three separate releases of coal laden sediment to short circuit the system and discharge into Eccles Creek. Citation 10028 was issued for failure to maintain. The abatement date is to stop the release of coal laden sediment immediately and to repair the discharge structure by September 15, 2008.

4.d Hydrologic Balance: Water Monitoring

First quarter 2008 water monitoring is in the EDI website and has been uploaded. Second quarter 2008 water monitoring is in the EDI website, but has not been uploaded. Water monitoring is current.

7. Coal Mine Waste, Refuse Piles, Impoundments

The refuse pile located near the town of Scofield was last inspected and P.E. certified on July 14,, 2008. No problems were noted.

20. Air Quality Permit

The Air Quality Permit Approval Order DAQE-AN0092007-03 was issued on June 24, 2003. The permit remains effective.

21. Bonding and Insurance

The current bond is \$5,137,000.00 as of September 19, 2006. The previous bond amount was \$5,076,000.00.

2007 Annual Report Review

Permittee: Canyon Fuel Company, LLC
Mine Name: Skyline Mine
Permit Number: C/007/0005
Date Report Received: June 26, 2008

Assigned Reviewer: Karl R. Houskeeper

Date Completed
 July 30, 2008

Instructions: The assigned inspector will review the Annual report during the third quarter complete inspection and provide a written determination (finding) on how the mine has or has not met the permit requirements for reporting. If the report is deficient or remedial action is required to obtain compliance, this should be noted and the mine lead notified. A copy of this review will be filed with the Inspection Report. Should any of the sections require additional technical analysis, the inspector will notify the permit supervisor so that it can be scheduled during the 4th quarter.

SECTIONS TO REVIEW

SUBMITTED
 YES NO NA

FINDINGS

Cover Sheet	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
General Information	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Identification of other Permits	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Annual Impoundment Certification	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Annual Overburden, Spoil, Refuse, Floor, etc. Certified Report	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Appendix A contains a copy of the refuse pile certifications and the impoundment inspections and annual certification.

Annual Technical Requirements (Commitments)				
Climatological	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Subsidence	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A subsidence map that shows cumulative subsidence contours through 2007 is contained in the 2007 annual report. The contours are at 2 foot intervals and were derived from aerial surveys.
Vegetation monitoring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Vegetation reports were submitted as part of the 2007 annual report. The reports should be reviewed by a Division Biologist.
Raptor Survey	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Soils Monitoring	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Water Monitoring	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Geological/Geophysical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Engineering	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Non-Coal Waste	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Abandoned Underground Equipment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

AVS; Legal/ Financial Update	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Mine Sequence Map	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Marked Confidential.
Other Information	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

2007 Annual Report Review

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Relations Between Health Indicators and Residential Proximity to Coal Mining in West Virginia

Michael Hendryx, PhD, and Melissa M. Ahern, PhD

We used data from a survey of 16 493 West Virginians merged with county-level coal production and other covariates to investigate the relations between health indicators and residential proximity to coal mining. Results of hierarchical analyses indicated that high levels of coal production were associated with worse adjusted health status and with higher rates of cardiopulmonary disease, chronic obstructive pulmonary disease, hypertension, lung disease, and kidney disease. Research is recommended to ascertain the mechanisms, magnitude, and consequences of a community coal-mining exposure effect. (*Am J Public Health*. 2008;98:669–671. doi:10.2105/AJPH.2007.113472)

TABLE 1—Health Status and Rates of Disease Among Adults (N = 16 493), by County Coal-Production Levels: West Virginia, 2001

	County Coal Production ^a			P	Bonferroni P
	0 Tons	≤3.9 Million Tons	≥4.0 Million Tons		
Health status, ^b mean score	2.62	2.68	2.85	<.001	.002
Any cardiopulmonary disease, %	13.5	13.8	15.9	<.001	.007
Lung disease, %					
Any lung disease	4.2	4.6	5.7	<.001	.007
Chronic obstructive pulmonary disease	1.6	1.5	2.1	.05	.85
Asthma	2.6	2.6	3.1	.27	.999
Black lung	0.3	0.7	0.8	<.001	.003
Heart disease or stroke, %					
Any heart disease	10.4	10.6	12.3	.004	.068
Hypertension	5.6	5.5	7.6	<.001	.002
Congestive heart failure	0.9	0.7	0.6	.17	.999
Arteriosclerosis	0.3	0.4	0.3	.57	.999
Cardiovascular disease	1.3	1.2	1.4	.90	.999
Stroke	0.5	0.4	0.6	.41	.999
Angina or coronary disease	5.4	5.6	5.4	.87	.999
Diabetes, %	6.2	5.7	7.0	.043	.73
Kidney disease, %	0.4	0.4	1.0	<.001	.002
Cancer, %	2.3	1.8	2.2	.26	.999
Arthritis or osteoporosis, %	5.5	5.4	6.4	.069	.999

^aThe division of coal production at 4 million tons groups coal-producing counties approximately in half. The effects of coal production on health are usually still present when the division occurs at 3 million tons or 2 million tons, but a division at 4 million tons resulted in a better fit of observed-to-expected level 2 residuals in the Table 2 hierarchical models. The category "≤3.9 million tons" does not include 0 tons as a measure.

^bScore was based on self-reported health (1 = "excellent"; 6 = "very poor").

The United States has 27% of known coal reserves,¹ and as many as 153 new coal-fired power plants are scheduled for operation by 2030.^{2,3} Pressure to increase coal mining is likely to intensify because of concerns about nuclear power, energy security, and peak global oil production.^{4–6} Increased coal demand may exacerbate negative health effects of coal-mining activities, including occupational hazards of coal mining,^{7,8} air pollution from burning coal,⁹ health consequences of carbon dioxide–caused climate change,^{10,11} and community exposure to mining activities. We examined whether coal mining in West Virginia is related to poorer health status and incidence of chronic illness. We sought to find whether coal mining effects may result only from socioeconomic correlates of mining such as income or education or whether effects persist after controlling for such factors,

which would suggest possible environmental exposure problems.

Quantitative research on health consequences of residential proximity to coal mining is limited to a few studies of respiratory illness conducted in Great Britain. One study found no effect of coal mining,¹² but others found elevated risks.^{13–15}

METHODS

In 2001, the West Virginia University Institute for Health Policy Research conducted a telephone survey of adults 19 years and older (N = 16 493; minimum number per county = 235). The response rate was 55%. We used 2000 US Census data to weight survey respondents to match the age, gender, income, education, and insurance status demographics of the state.

Dependent variables included self-reported health (scored 1 = "excellent" to 6 = "very poor") and the presence or absence of specific chronic health conditions.

We obtained 2001 coal production figures from the West Virginia Geological and Economic Survey,¹⁶ including the short tons of coal mined from each county in both underground and surface mines. Coal production was not normally distributed, so we divided county coal production into 3 dummy variables: (1) no production, (2) up to 3.9 million tons, and (3) 4.0 million tons or greater.

County-level covariates included smoking and obesity rates from the West Virginia Department of Health and Human Resources, percentage of the population below the poverty level from US census data, and a measure of social capital.¹⁷ Person-level covariates included age, gender, income,

education, and presence or absence of health insurance.

We analyzed whether health measures were associated with unadjusted coal production categories. Then we examined whether coal effects persisted after accounting for other person- and county-level variables with person-level HLM 6.03¹⁸ multi-level modeling: linear modeling for health status and nonlinear REML Bernoulli modeling for the dichotomous presence of chronic illness. The intercept effect was random, and other effects were fixed. Results are reported for final population estimates with robust standard errors.

RESULTS

As coal production increased, health status worsened, and rates of cardiopulmonary disease, lung disease, cardiovascular disease, diabetes, and kidney disease increased (Table 1). Within larger disease categories, specific types of disease associated with coal production included chronic obstructive pulmonary disease (COPD), black lung disease, and hypertension.

Dependent variables at $P < .10$ from Table 1 (non-Bonferroni corrected) were carried forward for the multilevel analyses (Table 2). The highest level of mining (≥ 4.0 million tons) predicted greater adjusted risk for cardiopulmonary disease, lung disease, hypertension, black lung disease, COPD, kidney disease, and poorer adjusted health status.

We considered the possibility that results reflected current or former coal miners living in the area. Almost all coal miners are men. The finding for black lung disease likely reflects a miner's effect, supported by the result that women are at lower risk. The only other illness for which men as a group had higher risk was the general cardiopulmonary category. We conducted an additional multilevel model (results not shown) separately for women for this category; the effects of the coal production variable remained significant.

DISCUSSION

Among West Virginia adults, residential proximity to heavy coal production was

TABLE 2—Hierarchical Model Results for Health Status and Rates of Disease Among Adults (N = 16 493): West Virginia, 2001

Model	Coal Variables Only ^a	Full Models ^b
Worse health status, ^c b (SE)		
≤3.9 million tons of coal	0.057 (0.052)	0.024 (0.039)
≥4.0 million tons of coal	0.205 (0.066)	0.094 (0.032)
Cardiopulmonary disease, OR (95% CI)		
≤3.9 million tons of coal	1.029 (0.924, 1.147)	1.006 (0.910, 1.113)
≥4.0 million tons of coal	1.204 (1.033, 1.405)	1.119 (1.002, 1.249)
Lung disease, OR (95% CI)		
≤3.9 million tons of coal	1.117 (0.931, 1.340)	1.085 (0.904, 1.303)
≥4.0 million tons of coal	1.385 (1.138, 1.685)	1.297 (1.048, 1.605)
Chronic obstructive pulmonary disease, OR (95% CI)		
≤3.9 million tons of coal	0.969 (0.596, 1.577)	0.909 (0.582, 1.419)
≥4.0 million tons of coal	1.559 (1.069, 2.272)	1.637 (1.061, 2.526)
Black lung or external agent, OR (95% CI)		
≤3.9 million tons of coal	2.256 (1.273, 3.998)	2.254 (1.255, 4.047)
≥4.0 million tons of coal	2.608 (1.548, 4.392)	2.655 (1.602, 4.402)
Cardiovascular disease, OR (95% CI)		
≤3.9 million tons of coal	1.016 (0.908, 1.137)	0.994 (0.890, 1.110)
≥4.0 million tons of coal	1.186 (1.016, 1.384)	1.106 (0.990, 1.236)
Hypertension, OR (95% CI)		
≤3.9 million tons of coal	0.967 (0.826, 1.133)	0.956 (0.820, 1.116)
≥4.0 million tons of coal	1.371 (1.153, 1.631)	1.299 (1.130, 1.493)
Kidney disease, OR (95% CI)		
≤3.9 million tons of coal	0.792 (0.420, 1.495)	0.764 (0.397, 1.470)
≥4.0 million tons of coal	2.147 (1.371, 3.362)	1.698 (1.016, 2.837)
Diabetes, OR (95% CI)		
≤3.9 million tons of coal	0.928 (0.807, 1.068)	0.898 (0.773, 1.042)
≥4.0 million tons of coal	1.135 (0.911, 1.414)	1.008 (0.864, 1.176)
Arthritis or osteoporosis, OR (95% CI)		
≤3.9 million tons of coal	1.030 (0.878, 1.210)	0.994 (0.844, 1.170)
≥4.0 million tons of coal	1.233 (1.021, 1.488)	1.097 (0.901, 1.335)

Note. OR = odds ratio; CI = confidence interval. The category "≤3.9 million tons" excludes 0 tons as a measure.

^aIncludes only the 2 level-2 dummy variables measuring tons of coal mined, where zero coal mined is the reference category. Fifty-five counties were measured.

^bFull models include adjustment for respondent age (19–25, 26–34, 35–44, 45–54, 55–64, 65–74, ≥75 years), gender, income (<\$30 000, ≥\$30 000), education (less than high school, high school, some college, college graduate or higher), health insurance (yes or no), county poverty rate, smoking rate, obesity rate, and social capital. Other analyses not shown here explored various ways to categorize age and income, with no substantive effects on results. Analyses also were conducted limited to persons 45 years and older, and coal effects persisted for all response variables except kidney disease. N = 16 493 for level-1 variables and 55 for level-2 variables.

^cScore was based on self-reported health (1 = "excellent"; 6 = "very poor"). For the coal-only model, the ≥4.0 million tons variable is significant at $P < .004$; for the full model, it is significant at $P < .005$.

associated with poorer health status and with higher risk for cardiopulmonary disease, chronic lung disease, hypertension, and kidney disease, after we controlled for covariates.

Limitations of the study included the ecological design and the possibility that unmeasured variables confounded with coal mining,

such as individual smoking behavior or occupational exposure, contributed to poorer health. Second, the survey response rate was imperfect, potentially limiting generalizability, although responses were weighted to census data. Third, county of residence provides an imperfect estimate of people's

proximity to mining sites. Fourth, the format of the chronic disease questions likely resulted in an underreporting of disease. Fifth, the nonspecific cancer measure may have been too crude to detect effects, if they existed. The third through fifth limitations may have resulted in underestimating coal-mining effects.

For illnesses that were associated with coal effects, the literature supports the hypothesis that the risk for these illnesses increases with exposure to coal byproducts. Toxins and impurities present in coal have been linked to kidney disease¹⁹⁻²³ and to hypertension and other cardiovascular disease.²⁴⁻²⁸ The effects also may result from the general inflammatory or systemic consequences of inhaled particles.²⁹ Effects may be multifactorial, a result of slurry holdings that leach toxins into drinking water³⁰ and air pollution effects of coal mining and washing.^{15,31,32}

Our study serves as a screening test to examine whether coal mining poses a health risk for adults living near the mining sites. Confirmatory tests should be undertaken to establish mechanisms of action, magnitude, and health consequences of an exposure effect. ■

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This brief was accepted August 16, 2007.

Contributors

M. Hendryx originated the study, collected and analyzed the data, and led the writing of the brief. M.M. Ahern contributed to study conceptualization, analyses, and writing.

Human Participant Protection

This was an analysis of anonymous, secondary data sources, and institutional review board approval was not required.

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Mortality from heart, respiratory, and kidney disease in coal mining areas of Appalachia

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Received: 11 November 2007 / Accepted: 28 April 2008 / Published online: 7 May 2008
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Abstract

Purpose The purpose of this study was to test whether population mortality rates from heart, respiratory and kidney disease were higher as a function of levels of Appalachian coal mining after control for other disease risk factors.

Methods The study investigated county-level, age-adjusted mortality rates for the years 2000–2004 for heart, respiratory and kidney disease in relation to tons of coal mined. Four groups of counties were compared: Appalachian counties with more than 4 million tons of coal mined from 2000 to 2004; Appalachian counties with mining at less than 4 million tons, non-Appalachian counties with coal mining, and other non-coal mining counties across the nation. Forms of chronic illness were contrasted with acute illness. Poisson regression models were analyzed separately for male and female mortality rates. Covariates included percent male population, college and high school education rates, poverty rates, race/ethnicity rates, primary care physician supply, rural-urban status, smoking rates and a Southern regional variable.

Results For both males and females, mortality rates in Appalachian counties with the highest level of coal mining were significantly higher relative to non-mining areas for chronic heart, respiratory and kidney disease, but were not higher for acute forms of illness. Higher rates of acute heart and respiratory mortality were found for non-Appalachian coal mining counties.

Conclusions Higher chronic heart, respiratory and kidney disease mortality in coal mining areas may partially reflect environmental exposure to particulate matter or toxic agents present in coal and released in its mining and processing. Differences between Appalachian and non-Appalachian areas may reflect different mining practices, population demographics, or mortality coding variability.

Keywords Heart disease · Respiratory disease · Kidney disease · Mortality · Coal mining · Appalachia

Introduction

Exposure to environmental pollutants increases risks for heart, respiratory and kidney disease. For example, low levels of environmental lead exposure accelerate progressive renal insufficiency in patients with chronic kidney disease (Lin et al. 2006), and environmental lead increases cardiovascular mortality in the general population (Menke et al. 2006). Mercury from industrial activity has been linked to kidney disease mortality (Hodgson et al. 2007). Arsenic in drinking water increases mortality from cardiovascular and kidney disease (Meliker et al. 2007). Cadmium exposure increases risk of renal dysfunction (Nishijo et al. 2006; Noonan et al. 2002). In addition to toxic agents, particulate matter (PM) from fossil fuel combustion increases risks for cardiovascular and respiratory disease morbidity and mortality (Barnett et al. 2006; Miller et al. 2007; Pope et al. 2002; Sarnat et al. 2006; Wellenius et al. 2006).

Appalachia is the mountainous, largely rural area in the eastern United States consisting of 417 counties and independent cities in 13 states. Previous research has identified that rates of cardiovascular, respiratory, and total mortality are higher in Appalachia compared to the rest of the country

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(Barnett et al. 1998, 2000; Cakmak et al. 2006; Halverson et al. 2004). Furthermore, heart disease mortality in Appalachia is higher in rural areas of the region compared to metropolitan areas (Barnett et al. 1998). Comparative rates for kidney disease have not been reported. Higher mortality rates in Appalachia are believed to result from higher smoking rates, poor dietary and exercise habits, and the correlates of poor socioeconomic conditions characteristic of the region such as limited access to health care.

However, another potential impact on the health of the population may originate from the environmental impacts of Appalachian coal mining. Coal mining constitutes a major industrial activity for eight Appalachian states (Alabama, Kentucky, Maryland, Ohio, Pennsylvania, Tennessee, Virginia and West Virginia), where 390 million tons were mined in 2004 (Frema 2005). Residents of Appalachian coal mining communities report exposure to contaminated air and water from coal mining activities and express concerns for resulting illnesses (Goodell 2006), but empirical evidence on community health risks from coal mining activities is limited (Brabin et al. 1994; Hendryx and Ahern 2007; Hendryx et al. 2007, 2008; Higgins et al. 1969; Temple and Sykes 1992). Coal contains toxic impurities including zinc, cadmium, lead, mercury, arsenic and many others (WVGES 2007), and the mining and cleaning of coal at local processing sites creates large quantities of ambient particulate matter and contaminated water (Ghose and Banerjee 1995; Ghose and Majee 2000; Orem 2007; Stout and Papillo 2004). Not only toxic impurities, but the particulate matter from coal itself released into air or water during mining or processing may be a health hazard. Shiber (2005) reports elevated arsenic levels in drinking water sources in coal mining areas of central Appalachia, and McAuley and Kozar (2006) report that groundwater from sampled domestic wells near reclaimed surface coal mines, compared to wells in unmined areas, has higher levels of mine-drainage constituents including aluminum, iron, manganese, and others. It should be noted, however, that the chemical composition of coal slurry is largely undefined (Orem 2007) and that arsenic and other elements may result from various sources and may be present even in areas where no coal mining takes place. The objective of the current study was to determine whether heart, lung and kidney disease mortality rates in Appalachia are attributable to smoking, poverty, education, and other demographics, or whether there is an additional effect linked to residence in coal mining areas.

Methods

This study investigated mortality rates for the years 2000–2004 for heart, respiratory and kidney disease. The study is an analysis of anonymous, secondary data sources and met

university Internal Review Board standards for an exemption from human subjects review.

Mortality data were obtained from the Centers for Disease Control and Prevention (CDC). These data measure county-level mortality rates per 100,000 population, age-adjusted using the 2000 US standard population (CDC 2007b). Disease categories were based on ICD-113 Groups provided by the CDC, which were cross-walked to ICD-10 Codes (The ICD-10 codes are provided in the parentheses in the Table 1 footnote). Diseases were grouped into acute or chronic conditions as shown in Table 1. Specifically excluded were codes for “pneumoconioses and chemical effects”, and “pneumonitis due to solids and liquids”, as these are established as occupational hazards related to coal mining, rather than potential population risks. Also excluded were several low-incidence categories for “other” or “unspecified” forms of disease or other low-incidence mortality causes. Because most coal miners are men, mortality rates were investigated separately for males and females to test the hypothesis that mining effects would be present for both sexes; support of this hypothesis suggests that results are not attributable to occupational exposure.

Coal production data were obtained from the energy information administration (Frema 2001, 2002, 2003, 2004, 2005). Production was measured as tons of coal mined in the county in both surface and underground mines. Analyses divided Appalachian coal mining into two levels: up to 4 million tons, and more than 4 million tons for the years 2000–2004. The choice of 4 million tons divided the number of coal mining counties approximately in half. Because the focus in this paper is on Appalachian coal mining, 97 non-Appalachian counties where coal mining took place were included as a separate category.

Covariates were taken from the 2005 Area Resource File (ARF 2006), CDC BRFSS smoking rate data (CDC 2007a), and the Appalachian Regional Commission (ARC 2007). Selection of covariates was based on previously identified risk factors or correlates of heart, respiratory or kidney disease (Barnett and Halverson 2001; Barnett et al. 2000; Hoffman and Paradise 2007; Iverson et al. 2005; Jones-Burton et al. 2007; Kunitz and Pesis-Katz 2005; Mannino and Buist 2007; Murray et al. 2005; Ziembrski and Brieding 2006). Covariates included percent male population, college and high school education rates, poverty rates, race/ethnicity rates, health uninsurance rates, physician supply, rural–urban continuum code, smoking rates, and Southern state (yes or no). Specific race/ethnicity groups included percent of the population who were African American, Native American, Non-white Hispanic, and Asian American (using White as the referent category in regression models). Rural–urban continuum was scored on a nine-point scale from least to most rural. Physician supply was the number of active MDs and DOs per 1,000 population. A

Table 1 Descriptive summary of study variables by county category

	County category			
	No mining	Non-Appalachian mining	Appalachian mining ≤ 4 million tons	Appalachian mining > 4 million tons
Number of counties	2,914	97	66	63
Total population	274,502,126	4,234,505	5,287,206	3,762,685
Age-adjusted annual number of deaths				
Chronic heart disease ^a	303,319	9,948	7,421	8,550
Acute heart disease ^b	302,316	11,028	8,313	8,117
Chronic respiratory disease ^c	138,777	4,921	3,601	3,871
Acute respiratory disease ^d	67,513	2,423	1,726	1,639
Chronic kidney disease ^e	44,418	1,526	1,252	1,284
Acute kidney disease ^f	171	3	5	4
Covariates				
Smoking rate	23.0	24.0	27.7	29.2
Percent male	49.9	50.0	49.5	49.1
Percent African American	9.3	4.9	2.6	3.2
Percent Native American	1.9	4.9	0.2	0.2
Percent Hispanic	6.7	6.7	0.9	0.7
Percent Asian American	1.0	0.5	0.4	0.4
Percent with high school education	77.7	77.9	71.4	70.2
Percent with college education	16.8	14.8	12.3	11.5
Physicians per 1,000	1.3	1.2	1.3	1.5
Poverty rate	13.4	14.0	16.3	18.2
Percent Southern county	25.4	1.0	45.5	31.7
Mean urban–rural code	5.1	5.1	5.2	5.3

^a Includes hypertensive heart disease (ICD-10 code I11), atherosclerotic cardiovascular disease so described (I25), all other forms of chronic, ischemic heart disease (I25.8), and essential (primary) hypertension and hypertensive renal disease (I10, I12)

^b Includes acute myocardial infarction (I21), other acute ischemic heart diseases (I24), acute and sub-acute endocarditis (I33), diseases of pericardium and acute myocarditis (I31, I40), and heart failure (I50)

^c Includes chronic and unspecified bronchitis (J40–J42), emphysema (J43), asthma (J45), and other chronic lower respiratory diseases (J44)

^d Includes pneumonia (J12–J18), acute bronchitis and bronchiolitis (J20–J21), and unspecified acute lower respiratory infection (J22)

^e Includes chronic glomerulonephritis, nephritis and nephropathy not specified as acute or chronic, and renal sclerosis unspecified (N03–N05), and renal failure (N17–N19)

^f Includes acute and rapidly progressive nephritic and nephrotic syndrome (N00, N01)

dichotomous Southern variable was created to capture larger regional effects that partially overlap with Appalachia; Southern states included Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia. CDC smoking rates were available for states and some county-based metropolitan areas. In an effort to improve smoking data, the state public health websites for all 50 states were reviewed and more specific county-level smoking rate data were found for 30 states, sometimes for individual counties and sometimes for groups of counties. The state average was used only when the more specific rate was not available. Appalachian counties included the 417 counties and independent cities in 13 states as defined by the Appalachian Regional Commission (ARC 2007).

Analyses were conducted using Poisson multiple regression with a log link function to test for the association between residence in coal mining areas and mortality rates with control for covariates. The primary independent variable of interest is a categorical measure of coal mining exposure with four levels: no coal mining, non-Appalachian mining, Appalachian mining up to 4 million tons, and Appalachian mining greater than 4 million tons.

Results

Table 1 contains descriptive characteristics of the counties by the four exposure groupings: no mining, non-Appalachian mining, Appalachian mining up to 4 million tons, and

Appalachian mining greater than 4 million tons. Appalachia has higher smoking rates, higher poverty rates, and lower education levels, but smaller race/ethnicity minority populations, compared to the nation. Acute kidney disease was a rare cause of mortality, and therefore this mortality category was dropped from further analysis.

Bivariate correlations among independent variables were examined for multicollinearity. Two variables, poverty rate and percent without health insurance, were correlated at $r = 0.81$, and so the insurance rate variable was dropped from regression models.

The next steps of the analysis examined age-adjusted mortality rates, and tested whether there were mortality effects linked to coal mining after accounting for covariates. Age-adjusted rates before adjusting for covariates are shown in Tables 2 and 3 for males and females, respectively. Mortality rates are higher in Appalachian mining areas compared to other areas in every instance. Mortality rates for these conditions are higher for men than for women, but this is the case for both mining and non-mining areas.

Poisson regression model results adjusting for covariates are presented in Tables 2 and 3, one table each for males and females. The rate ratios (RR) were found after exponentiating the log values back to the original scale; these

figures represent the proportional increment in mortality rates per 100,000 relative to the non-mining reference category. For Appalachian mining areas, significantly higher mortality rates showed the same pattern for males and females. Among the Appalachian counties with the highest mining level, higher mortality rates were found for both males and females for total and chronic heart disease, total and chronic respiratory disease, and chronic kidney disease. Appalachian mining effects were stronger and more frequent in areas where mining was highest compared to areas of less-intense mining.

Coal mining areas outside Appalachia showed a similar but not identical pattern for males and females: for both sexes there were higher total and acute respiratory mortality, and higher acute heart disease mortality. Females, but not males, had significantly higher total heart disease mortality and chronic kidney disease mortality; males but not females had significantly higher mortality from chronic respiratory illness.

There were also instances where mortality was significantly lower than expected. For Appalachian coal mining areas, lower mortality was found for acute forms of heart and respiratory illness. In other words, higher mortality in Appalachian mining areas was specific to total and chronic forms of illness, while for non-Appalachian mining areas

Table 2 Male age-adjusted mortality rates per 100,000 population by mining category with 95% confidence interval (CI) in parentheses, followed by rate ratios (RR) and 95% CI adjusted for all covariates with non-mining as the referent

	Appalachian mining > 4 million	Appalachian mining up to 4 million	Non-Appalachian mining	Non-mining
Total heart				
Age-adjusted mortality	331 (316–346)	298 (287–309)	270 (257–283)	261 (259–263)
RR	1.07 (1.05–1.09)	1.01 (0.99–1.02)	1.01 (0.99–1.02)	–
Chronic heart				
Age-adjusted mortality	171 (160–181)	139 (129–149)	127 (119–136)	130 (128–131)
RR	1.28 (1.25–1.30)	1.06 (1.04–1.08)	0.96 (0.94–0.98)	–
Acute heart				
Age-adjusted mortality	160 (145–175)	159 (146–172)	143 (133–153)	132 (130–134)
RR	0.89 (0.87–0.91)	0.95 (0.93–0.97)	1.06 (1.04–1.08)	–
Total respiratory				
Age-adjusted mortality	113 (104–121)	105 (98–113)	96 (92–100)	90 (89–91)
RR	1.03 (1.00–1.05)	0.97 (0.95–0.99)	1.05 (1.02–1.07)	–
Chronic respiratory				
Age-adjusted mortality	81 (75–87)	74 (69–79)	67 (64–71)	63 (62–64)
RR	1.07 (1.04–1.10)	0.99 (0.97–1.03)	1.04 (1.02–1.06)	–
Acute respiratory				
Age-adjusted mortality	32 (28–36)	31 (27–35)	28 (26–31)	28 (27–28)
RR	0.94 (0.89–0.98)	0.92 (0.88–0.96)	1.05 (1.01–1.09)	–
Chronic kidney				
Age-adjusted mortality	25 (23–27)	22 (20–24)	18 (17–20)	19 (18–19)
RR	1.19 (1.13–1.25)	1.10 (1.05–1.16)	1.02 (0.98–1.06)	–

Table 3 Female age-adjusted mortality rates per 100,000 population by mining category with 95% confidence interval (CI) in parentheses, followed by rate ratios (RR) and 95% CI adjusted for all covariates with non-mining as the referent

	Appalachian mining > 4 million	Appalachian mining up to 4 million	Non-Appalachian mining	Non-mining
Total heart				
Age-adjusted mortality	213 (202–224)	192 (183–201)	174 (165–182)	165 (164–167)
RR	1.06 (1.04–1.08)	1.00 (0.98–1.02)	1.03 (1.02–1.05)	–
Chronic heart				
Age-adjusted mortality	109 (102–116)	92 (85–99)	83 (77–89)	84 (83–85)
RR	1.18 (1.15–1.21)	1.03 (1.00–1.05)	0.97 (0.95–0.99)	–
Acute heart				
Age-adjusted mortality	104 (94–114)	100 (92–108)	91 (85–96)	82 (80–83)
RR	0.95 (0.93–0.97)	0.97 (0.94–0.99)	1.10 (1.08–1.12)	–
Total respiratory				
Age-adjusted mortality	73 (68–78)	65 (61–70)	63 (59–66)	59 (58–59)
RR	1.03 (1.00–1.06)	0.94 (0.91–0.97)	1.05 (1.02–1.07)	–
Chronic respiratory				
Age-adjusted mortality	61 (57–66)	55 (51–58)	51 (48–53)	48 (47–48)
RR	1.11 (1.07–1.15)	0.94 (0.90–0.98)	1.01 (0.98–1.04)	–
Acute respiratory				
Age-adjusted mortality	26 (23–29)	26 (23–29)	25 (23–27)	23 (23–24)
RR	0.89 (0.84–0.94)	0.92 (0.87–0.97)	1.13 (1.08–1.18)	–
Chronic kidney				
Age-adjusted mortality	18 (16–19)	17 (16–19)	14 (13–15)	13 (13–14)
RR	1.13 (1.06–1.21)	1.14 (1.07–1.21)	1.08 (1.02–1.14)	–

mortality was elevated for acute heart and respiratory disease, and chronic kidney disease for females.

Finally, county-level coal mining data are reported for the nation by the Energy Information Administration only back to 1999. However, disease consequences of exposure are hypothesized to be long-term phenomena. Longer historical records of county-level coal mining are available on the websites of two state Geological Surveys, those for West Virginia and Kentucky; an examination of these sources indicated that 100% of counties categorized in the highest coal-mining group for the current study had high levels of coal mining extending back at least to 1986. Appalachian areas with large coal reserves have been mining coal for decades.

Discussion

Total and chronic heart, respiratory and kidney disease mortality rates are significantly higher in coal mining areas of Appalachia compared to non-mining areas of the country. Coal mining industrial activities may expose residents to environmental contaminants, or these geographic areas may be associated with additional behavioral or demographic characteristics not captured through other covariates.

The same effects are found for both males and females in Appalachia.

The different pattern of results in coal mining areas outside Appalachia was not expected. The different results may reflect differences in population demographics, migration patterns, mining practices, geographic topography, or population density [i.e., the population density of Appalachian coal mining areas (118 per square mile) is significantly higher than non-Appalachian mining areas (64 per square mile)]. Differences may also reflect variation in medical diagnostic practices that favor acute or chronic classifications; when considering total mortality rates, mining areas inside and outside Appalachia were elevated compared to non-mining areas.

Limitations of the study include the reliance on secondary county-level data. Causes of individual mortality cannot be identified, and the precise pathway between residence in coal mining areas and mortality is unknown. The phenomenon of environmental exposure occurs at an aggregate level, and as there is a risk of an ecological fallacy, so is there a risk of an atomistic fallacy by failing to account for the aggregate nature of the effect (Willis et al. 2003). More definitive research should be conducted using multi-level modeling of aggregate ecologic impacts on individual outcomes. An additional critical next research step is to collect

direct air and water samples in coal mining communities to test the hypothesis that increased mortality from these chronic diseases is linked to poorer air and water quality.

Another limitation is the use of smoking rates that were imprecisely measured. Smoking effects, including exposure to second-hand smoke linked to poorer socioeconomic conditions, may be underestimated. The smoking variable, however, did predict higher mortality rates across conditions and so operated as expected.

Not all risk factors could be measured, for example, kidney disease risks associated with diabetes or hypertension were not assessed. Behaviors such as physical activity levels and alcohol consumption could not be included. Demographic or cultural variables not captured through available covariates may be contributing factors; these variables might include Appalachian cultural beliefs such as fatalism (Coyne et al. 2006) that increase risk for poor health behaviors or delay early health care intervention, or weak tobacco control policies that increase second-hand smoke exposure.

Future research should collect direct measures of smoking, occupational exposure, duration of environmental exposure, and individual-level health and disease measures to confirm the findings suggested by this research. Research to examine the different mortality patterns in Appalachian and non-Appalachian areas is indicated. Additional research is also needed to identify exposure types, levels, and mechanisms of action that can account for higher mortality in coal mining areas. For example, research can determine if pollution from mining itself is a contributing factor or whether the coal processing, cleaning and transportation activities that take place after mining are more important, and can determine through direct air and water quality monitoring if one transmission route or the other, or both, contribute to poor health outcomes. The pattern of results and prior research suggest that water quality may be a factor for kidney disease, that air quality may be a factor for respiratory disease, and that either air or water problems may be related to heart disease.

Until recently, research on the community health impacts of Appalachian coal mining had been unavailable, and only anecdotal evidence (Goodell 2006; Loeb 2007) attested to the health impacts of living in proximity to mining activities. A body of evidence is beginning to emerge, however, that confirms the beliefs of local residents at least to some extent, and suggests that coal mining-related community health problems are real (Hendryx and Ahern 2008; Hendryx et al. 2007, 2008; Orem 2007; Shiber 2005; Stout and Papillo 2004). As evidence accumulates to reveal a previously unknown contributing factor to the infamous health disparities plaguing Appalachia, it becomes critical to address issues of environmental equity and to reduce environmental and socioeconomic disparity through economic and policy interventions. These interventions may include

establishing and enforcing stricter air and water quality standards in coal mining communities.

Acknowledgments This research was partially supported by a grant to the author from the Regional Research Institute, West Virginia University. The author gratefully acknowledges the assistance of Kathryn O'Donnell in the preparation of the data sets used in this study.

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